BARITE, CELESTITE and FLUORITE in NOVA SCOTIA

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INFORMATION CIRCULAR 15

88-04160/

Cover Photo: Celestite flotation mill, Enon, Cape Breton County.

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Nova Scotia Department
of Mines and Energy
Halifax, Nova Scotia
1988

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Introduction

Barite, celestite and fluorite are internationally traded commodities. Demand is concentrated in the industrialized countries of Europe, North America and Japan. Supplies are available in most regions of the world.

Approximately 85 per cent of the world production of barite is used as a weighting agent in oil and gas well drilling. The remaining 15 per cent is consumed for the manufacture of barium compounds, as a filler and extender in the manufacture of plastics, rubber, paint, adhesives and sealants, in glass making, ceramics and in pharmaceuticals.

Celestite, the principal source of strontium, is consumed primarily by the chemical industry where it is converted into strontium compounds, mainly strontium carbonate and strontium nitrate. Strontium carbonate is used in colour television picture tubes to shield against the emission of x-rays and to provide a clearer picture. Strontium carbonate is also used in the production of ceramic ferrite magnets, pigments, in the manufacture of glass, in the chemical and electronics industries, in zinc refining and in the manufacture of aluminum castings. The principal use for strontium nitrate is in manufacturing pyrotechnics.

Fluorite, the most important source of fluorine, is used in the manufacture of hydrofluoric acid and fluorine chemicals; as a fluxing agent in steel making; in the electrolytic reduction of alumina to aluminum; in refining of uranium ores; and, in the glass and ceramics industries.

MINING HISTORY

Barite

Barite mining in Nova Scotia has continued virtually uninterrupted since 1865. The earliest reported mining was at the Eureka Mine at Five Islands, Colchester County in 1865. In 1868 barite mining started at Stewiacke, Colchester County, followed by mining at Lake Ainslie and Cape Rouge, Inverness County in 1894, to produce barite for paint manufacturing. By 1900 Nova Scotia had seven producing barite mines, mostly to supply high-purity product to paint manufacturing plants within the Province. Several of these mines were operated by Henderson and Potts, a paint company based in Halifax. In 1912, Barytes Ltd. built the Province's first barite grinding mill at Scotsville, Inverness County, to process ore from nearby deposits. Production statistics from 1904 to 1920 show Nova Scotia deposits furnished most of the entire output of Canadian barite. Barite mining continued steadily until 1925, then waned until the discovery of the Walton, Hants County deposit in 1940. In 1951, Maritime Barytes Co. Ltd. developed a barite deposit at Upper Brookfield, Colchester County and erected a mill to produce high-purity filler grade barite. Inconsistent product grade forced this operation to close in 1952.

The economic possibilities of an occurrence of barite at Walton were not appreciated until 1940, when Springer Gold Mines Limited completed an extensive diamond drilling program which outlined Canada's largest barite mine, the Walton Mine. In 1941 a company was incorporated under the name Canadian Industrial Minerals Limited to develop the deposit, first as an open-pit mine, and later as an open-pit and underground mining operation. In 1955 Magnet Cove Barium Corporation, a subsidiary of Dresser Industries Inc., Dallas, Texas, purchased the property from Canadian Industrial Minerals Limited. Diamond drilling in 1956-57 discovered a lead-zinc-copper-silver ore body below the barite deposit and sulphide production began in 1961. In 1967 Magnet Cove Barium Corporation became Dresser Minerals which operated the mine until it closed in 1978. The Walton Mine produced barite for 38 years. Most of the barite was shipped to the United States and Caribbean destinations where it was used as a weighting agent in drilling fluids

with smaller amounts shipped to the Middle East for the same purpose. Lesser amounts of chemical and filler grade barite were shipped to Central Canadian markets. During the operating life of the Walton Mine, 4.3 million t of barite were produced from the open-pit and underground. In 1976 the Mine was placed on a phase-out schedule and on February 15, 1978 production at Walton ceased, leaving an estimated 900 000 t of barite underground.

After the closure of the Walton Mine, barite mining came to an end until the development in 1980 of the Upper Brookfield barite-siderite deposit and the construction of a processing plant at Debert, Colchester County, by Nystone Chemicals Ltd. to produce pharmaceutical-grade barium sulphate. This was followed by the opening of an open-pit barite mine at Lake Uist, Richmond County in 1983, by Novex Mining and Exploration Company Limited to produce drill mud grade barite. Two other barite properties were developed to produce drill mud grade barite. Magcobar Dresser Canada mined barite from a small high grade deposit at Bass River, Colchester County in 1984-1985. In 1985 Scotsville Mineral Resources developed the MacInnis barite deposit at Scotsville, Inverness County. Only Nystone Chemicals Limited is producing barite in Nova Scotia today.

Celestite

Significant deposits of celestite were discovered by Lura Corporation at Enon, Cape Breton County in 1962 and these low grade deposits were developed by Kaiser Celestite Mining in 1970. A concentrator to upgrade the ore was constructed on site and a chemical plant was built at Point Edward 60 km northeast of the mine. The first shipment of celestite concentrate from the Enon mill to the chemical plant was in 1971. At the Point Edward plant the concentrate was converted to $SrCO_3$, $Sr(NO_3)_2$, Na_2SO_4 and $Sr(OH)_2$. Operations continued until 1976 when production ended because of lost markets to higher grade deposits in Mexico.

BARITE PRODUCTION

Nystone Chemicals Limited is the only barite producer in Nova Scotia. Nystone has a barite-siderite deposit in Early Carboniferous sediments at

Upper Brookfield, Colchester County. This open-pit mine supplies ore to the Nystone processing plant at Debert, Colchester County. The mill circuit at the plant consists of gravity separation, magnetic separation, acid leaching and ultra fine grinding in a paddle mill to produce USP pharmaceutical grade barium sulphate. This product is shipped to E-Z-EM, Inc. in Westbury, New York, U.S.A. where it is prepared and packaged into barium kits which are sold to hospitals and medical clinics.

GENERAL GEOLOGY OF NOVA SCOTIA BARITE, FLUORITE AND CELESTITE

Nova Scotia has over 70 identified occurrences and deposits of barite, celestite and fluorite. Seventy per cent of these occurrences are hosted by sedimentary rocks, mostly of Early Carboniferous age. Mineralization occurs as fissure fillings, pore space fillings or solution cavity fillings and as replacement deposits. Seventeen per cent of the occurrences are found in igneous rocks. The intrusive host rocks are Devonian age and the extrusive rocks are either Early or Late Carboniferous age. The mineralization is fissure filling type. The remaining 13 per cent of the occurrences are the fissure filling type hosted by metamorphic rocks ranging in age from Precambrian to Silurian (Felderhof, 1978).

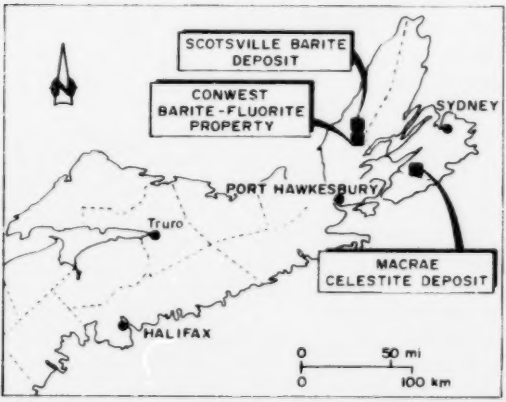

Figure 1. Location of major barite, celestite and fluorite deposits.

BARITE-FLUORITE

Two properties having very good development potential in Nova Scotia are the Scotsville barite deposits at Scotsville, Inverness County and the Conwest barite-fluorite deposits at East Lake Ainslie, Inverness County (Fig. 1). At Scotsville, drill mud grade barite was produced in 1985 by Scotsville Mineral Resources at the MacInnis open-pit Mine.

The Conwest barite-fluorite property has large undeveloped reserves of barite and fluorite. The property is owned by Conwest Exploration Company Limited of Toronto, Ontario.

Scotsville Barite Deposits

The Peter Campbell Mine and the MacInnis Mine (Plate 1) occur near Scotsville, Inverness County at the northeastern corner of Lake Ainslie. Access is by Highway 395 which leads from Whycocomagh, Inverness County situated on Trans-Canada Highway 105. These deposits are commonly referred to as the Scotsville barite deposits. Both occur in what is known as the Scotsville inlier, a northward-trending belt composed of Precambrian, Devonian and Early Carboniferous rocks, forming a highland area along the northeastern side of Lake Ainslie.

Plate 1. MacInnis Mine, Scotsville, Inverness County, 1985.

In 1984 Scotsville Mineral Resources began mining at the MacInnes Mine. Site development work included clear cutting, stripping, road construction, water reservoir development, construction of concrete foundation for ore processing equipment and the establishment of waste disposal sites. The barite orebody occurs at the

base of the Lower Carboniferous Horton Group sediments, which unconformably overlie George River Group metasedimentary rocks and intrusive rocks of Precambrian age. Most of the barite occurs within the basal Horton breccia which dips from 35° to 60° east. Ore reserves to a depth of 45 m are estimated at 95 000 t having an average grade of 60 per cent $BaSO_4$. Additional reserves are drill inferred below 45 m. Minor amounts of fluorine and trace amounts of pyrite, chalcopyrite and malachite are the only mineral contaminants and these do not impede the jigging of the barite to mud grade specifications. During the early 1900s 10 000 t of barite from this deposit was used for paint manufacturing. Approximately 25 000 t of barite are immediately available at the MacInnis deposit requiring a minimum of stripping.

The Peter Campbell Mine and several other barite veins at Scotsville are good exploration targets. There is no barite mining in this area at the present time.

Conwest Barite-Fluorite Deposits

Conwest Exploration Company Limited owns an undeveloped barite-fluorite property at East Lake Ainslie, Inverness County. Access to the property is by Highway 395 which leads from the Trans-Canada Highway 105 at Whycocomagh, Inverness County.

The property has nine barite-fluorite veins with reserves estimated at 4.1 million t averaging 33.4 per cent barite and 17.4 per cent fluorite. These deposits have been developed along fault cavities and subsidiary tension fractures and shears mostly in rhyolitic tuff of the Early Carboniferous Fisset Brook Formation. One exception is the western ore extension of one of the veins which lies along the fault contact of the tuff and Horton Group sedimentary rocks. Two of these deposits: the Campbell-MacMillan deposit and the Upper Johnson deposit contain the major tonnage of barite-fluorite. The Campbell-MacMillan vein strikes east-west and has a 65° to 70° southerly dip. Reserves have been calculated at 2.6 million t averaging 27.8 per cent barite and 19 per cent fluorite. The Upper Johnson vein (Plate 2) strikes S85°W and dips 85° north to vertical. Reserves are calculated at 960 000 t of 45 per cent barite and 17 per cent fluorite.

Metallurgical studies and pilot plot testing show that mud grade barite and metallurgical grade and acid grade fluorspar can be produced from these deposits. A program is currently underway to determine the suitability of the barite for the manufacture of specialty barite compounds. At present there is no mining activity at any of these deposits.

Plate 2. Upper Johnson barite-fluorite vein, Conwest property.

BARITE OCCURRENCES

Nova Scotia has numerous other barite occurrences; many have been small producers in the past. The best occurrences for prospecting are those found in Windsor Group rocks of Early Carboniferous age found on mainland Nova Scotia and Cape Breton Island. The Pine Brook barite property near the Community of Lake Uist, Richmond County did produce mud grade barite in 1983. This barite occurs as an irregular replacement of limestone member in Windsor Group sedimentary rocks. Exploration programs are necessary to establish barite reserves at all of these occurrences.

CELESTITE DEPOSITS

The most significant celestite deposits in Nova Scotia are those occurring in the Loch Lomond Sedimentary Basin near the Village of Enon, Cape Breton County. These deposits are known as the Enon, Amac and MacRae deposits. The Enon and MacRae deposits were mined by Kaiser Celestite Mining from 1970 to 1976. Kaiser mined 272 000 t of ore from these deposits and ran it through their 450 t/day flotation concentrator at Enon. The concentrator upgraded the ore to over 90 per cent celestite prior to shipping to their own chemical plant

Table 1. Summary of celestite ore zones, MacRae Deposit,

Ore Zone	Thickness (m) Range	Average
Zone 1	2.4-2.7	2.5
Zone 2	0.6-9.1	3.7
Zone 3	0.6-7.0	3.1
Zone 4	0.3-1.5	0.5

at Point Edward, Cape Breton County, where it was converted to $SrCO_3$, $Sr(NO_3)_2$, Na_2SO_4 and $Sr(OH)_2$.

Macrae Celestite Deposit

The MacRae celestite deposit (Fig. 2) has excellent development potential. This deposit is 50 km south of Sydney and 80 km north of the deep water ocean port at the Strait of Canso.

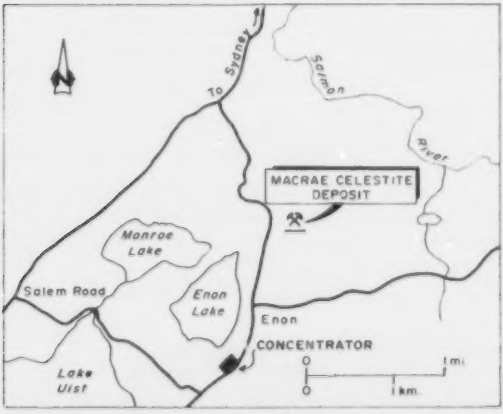

Figure 2. Location of MacRae celestite deposit, Enon, Cape Breton County.

nodified from Feldrhof, 1978, p. 92).

Host Rock	Mineralization
Celestite replacing limestone	Celestite, massive and disseminated, fine to coarse-grained, light grey to grey-brown.
Celestite replacing silty limestone	Celestite, massive, very dense, brittle, light grey to brown, medium to coarse-grained.
Celestite replacing silty limestone conglomerate	Celestite medium- to coarse-grained vuggy with vugs lined with celestite crystals.
Celestite replacing silty limestone conglomerate	Celestite, medium grained, light brown.

Kaiser Celestite Mining drilled 90 diamond-drill holes in the MacRae deposit and intersected four celestite zones, indicated stratigraphically from bottom to top as zones 1, 2, 3 and 4 with zones 2 and 3 considered mineable. The ore zones are celestite replacement in silty limestone and silty limestone conglomerates. These tabular ore zones dip from 17° to 20° to the northwest and are separated by conglomerate and limestone. Ore zones 2 and 3 contain in excess of 500 000 t of mineable celestite with an average grade of over 50 per cent. A summary of the MacRae celestite ore zone is shown in Table 1. It is significant to note that the flotation mill constructed by Kaiser is still standing and could be used to upgrade the MacRae ore (Plate 3). At the present time Timminco Limited of Toronto holds a special license on the MacRae deposit and is examining its development potential.

Plate 3. Flotation concentrator at Enon, Cape Breton County.

Celestite Occurrences

Along with the celestite deposits at Enon, Cape Breton County, Nova Scotia has five known celestite occurrences. All of these occurrences are hosted by Early Carboniferous age, Windsor Group rocks. Three occurrences are on Cape Breton Island and two are on mainland Nova Scotia. All of these occurrences have been prospected. The Beckwith, Cumberland County occurrence has received the most attention because of its high grade ore. The most recent work at Beckwith was the bulk sampling and metallurgical testing by Timminco Limited in 1986.

Fluorite Occurrences

Fluorite, other than the Conwest barite-fluorite deposits at Lake Ainslie, occurs at several locations in Devonian age granitic rocks and Lower Carboniferous sedimentary rocks. Most occurrences are found in granitic rocks in the New Ross area of Lunenburg County. All occurrences have been prospected and are considered as having no mining potential.

MINERAL RIGHTS

Barite, celestite and fluorite are minerals in Nova Scotia which are reserved to the Crown. A Crown mineral is defined as any material solid inorganic or fossilized organic substance and such other substances as are declared to be a mineral. A landowner or anyone else may acquire the mineral rights by making application for a mineral exploration license. The regulations and procedures for acquiring and maintaining a license are set forth in the Mineral Resources Act, Statutes of Nova Scotia. This act is administered by the Minister of Mines and Energy, Province of Nova Scotia.

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Table 1. Summary of celestite ore zones, MacRae deposit (modified from Felderhof, 1978, p. 92).

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Halifax, Nova Scotia
1988

Nova Scotia Department of Mines
and Energy, Information Circular
No. 15

Canada—Nova Scotia
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